BONNEVILLE POWER ADMINISTRATION

Habitat Evaluation Procedures (HEP) Report

Oxbow Conservation Area

Technical Report 2002 - 2005 | February 2005 | DOE/BP-00004037-5

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Confederated Tribes of the Warm Springs Reservation of Oregon
Oxbow Conservation Area
2002 Baseline Habitat Evaluation Procedure Report

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Abstract

This Habitat Evaluation Procedure (HEP) study was performed to determine baseline habitat units on the Oxbow Conservation Area in Grant County, Oregon. The evaluation is a required part of the Memorandum of Agreement between the Confederated Tribes of the Warm Springs and Bonneville Power Administration (BPA) relating to the acquisition and management of the Oxbow Conservation Area.

The HEP team was comprised of individuals from the Washington Department of Fish and Wildlife and the Confederated Tribes of the Warm Springs Reservation of Oregon. The survey was conducted using the following HEP evaluation models for key species: black-capped chickadee (*Poecile atricapilla*), mallard (*Anas platyrhynchos*), mink (*Mustela vison*), western meadowlark (*Sturnella neglecta*), white-tailed deer (*Odocoileus virginiana*), and yellow warbler (*Dendroica petechia*). Cover types used in this survey were conifer forest, irrigated meadow, riparian meadow, upland meadow, riparian shrub, upland shrub, and mine tailings.

The project generated 701.3 habitat units for mitigation crediting purposes. Results for each HEP species are summarized below. General ratings (poor, marginal, etc.) are described in the introduction section.

Black-capped chickadee habitat was good, with only isolated areas lacking snags or having low tree canopy cover.
Mallard habitat was poor in upland meadows and marginal elsewhere due to a lack of herbaceous/shrub cover and low herbaceous height.
Mink habitat was good, limited only by the lack of the shrub component.
Western meadowlark habitat was marginal in upland meadow and mine tailing cover types and good in irrigated meadow. Percent cover of grass and height of herbaceous variables were limiting factors.
White-tailed deer habitat was marginal due to relatively low tree canopy cover, reduced shrub cover, and limited browse diversity.
Yellow Warbler habitat was marginal due to less than optimum shrub height and the lack of hydrophytic shrubs.

Introduction

From the late 1800s until 1999, the Oxbow Ranch on the Middle Fork John Day River was privately owned and managed for agriculture purposes. In 1999, The Nature Conservancy purchased the property, which was then acquired by the Confederated Tribes of the Warm Springs Reservation of Oregon (Tribe) in 2001. The property, now known as the Oxbow Conservation Area, is now managed to benefit both fish and wildlife resources.

Habitat units gained as a result of the Oxbow project partially mitigates for construction and inundation losses at John Day Dam. The memorandum of agreement between the Tribe and BPA required a baseline wildlife habitat inventory on the Oxbow using HEP.

HEP is used extensively within the Northwest Power and Conservation Council's (NPCC) Columbia River Basin Fish and Wildlife Program. Wildlife managers use this procedure to determine habitat lost through the construction of the federal hydroelectric projects, as well as habitat gained through NPCC mitigation programs.

Habitat suitability index (HSI) models, based on the needs of a single wildlife species and/or species guild/assemblage, are used to identify changes in both habitat quality and quantity for specific habitat/cover types. The "currency" used to estimate habitat losses and/or gains are habitat units (HU). Habitat units are calculated by multiplying HSI values (ranging from 0.0 to 1.0) by the number of acres for each cover type. HSI verbal equivalents are described in Table 1.

Table 1. A comparison of mathematical HSI scores and equivalent verbal expressions.

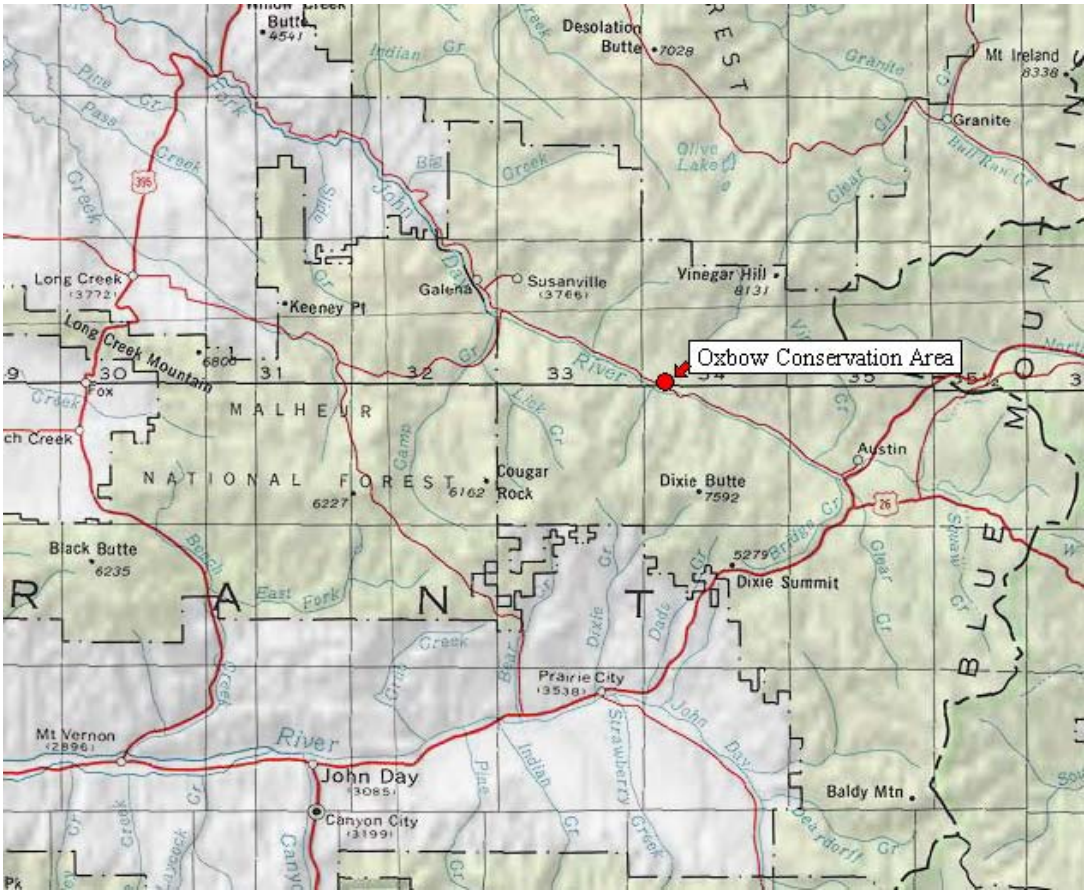
Habitat Suitability Index	Verbal Equivalent
0.0 < 0.2	Poor
0.2 < 0.4	Marginal
0.4 < 0.6	Fair
0.6 < 0.9	Good
0.9 < 1.0	Optimum

Study Area

The 1,022-acre Oxbow Conservation Area was selected as a mitigation site primarily for its fisheries habitat values, especially those values for spawning and rearing habitat for spring Chinook salmon and summer steelhead. The project includes over four miles of the Middle Fork John Day River and five perennial streams (Butte, Ruby, Ragged, Beaver, Corner, and Granite Boulder Creeks).

There are approximately 550 acres of riparian habitat, wetlands, meadows, and mine tailings and 472 acres of conifer forest on the Oxbow. The property is completely surrounded by Malheur National Forest lands, with the nearest private property located one mile down river (The Nature Conservancy's Dunston Preserve).

Figure 1. Location of Oxbow Conservation Area in Grant County, Eastern Oregon.



Methods

Survey Team

On May 28-30, 2002, a HEP team evaluated the baseline habitat conditions on the Oxbow Conservation Area. The HEP team consisted of the following members and agencies: Mark Berry, Brent Smith, Mike Callahan, and Rebekkah Haslam of the Confederated Tribes of Warm Springs Reservation of Oregon; Paul Ashley from Washington Dept. of Fish and Wildlife (WDFW) and Columbia Basin Fish and Wildlife Authority (CBFWA) Regional HEP team crew members.

Cover Types

GIS cover type maps were produced in 2002 from 1987 aerial photographs. Cover types such as roads, open water, and wetlands were not considered for HEP evaluation. There were seven cover types measured during the HEP (Table 3). Some cover types at the Oxbow are not directly comparable with cover types listed in the John Day Wildlife Impact Assessment (Rasmussen & Wright. 1989). In 2004, project GIS support staff updated Oxbow Conservation Area cover type maps. Habitat mapping refinements will continue as needed.

Figure 2. Map of Oxbow Conservation Area and cover types.

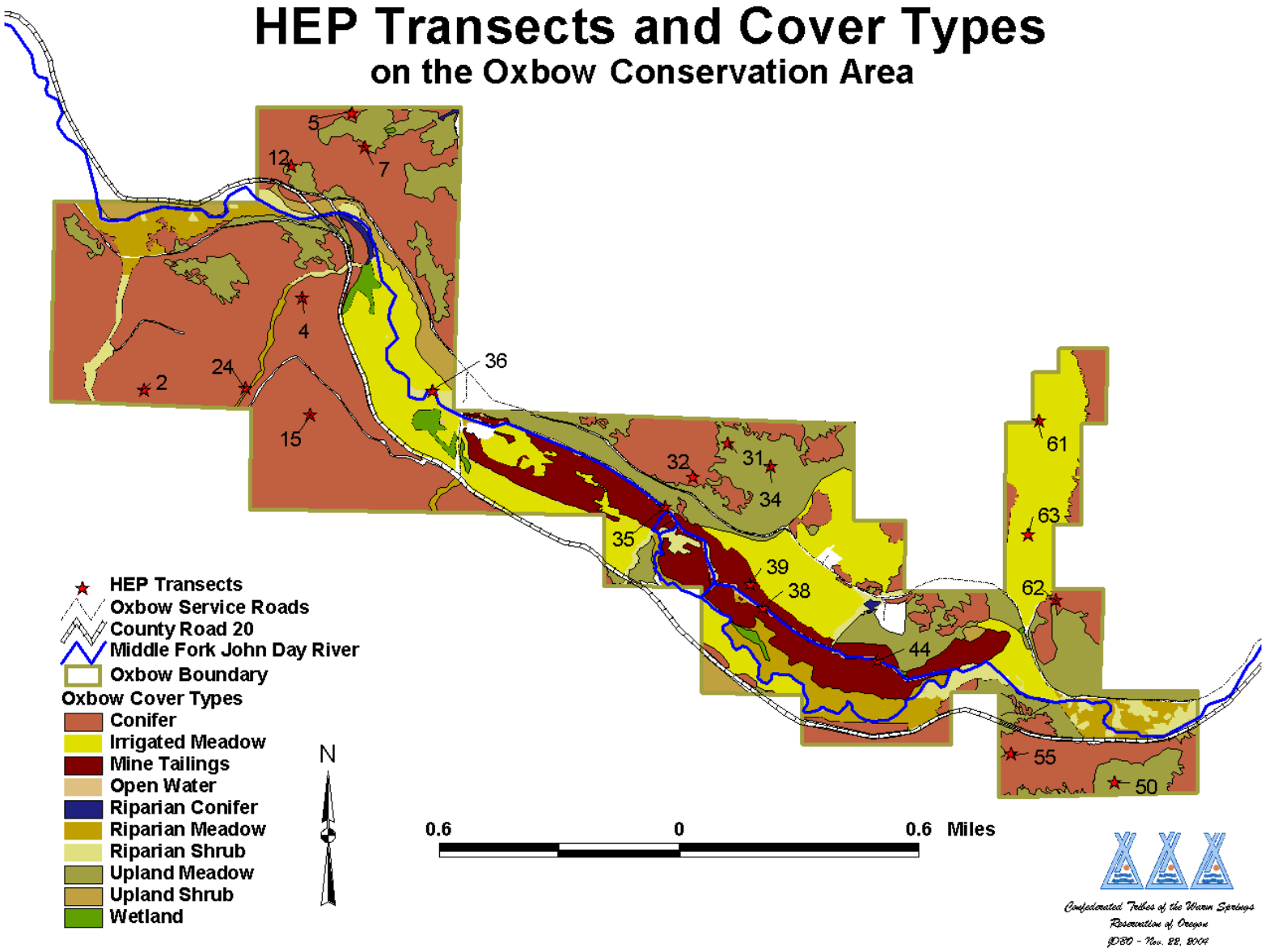


Table 2. Cover types on the Oxbow Conservation Area.

Cover Type	Acres
Conifer	429.76
Irrigated Meadow	184.75
Mine Tailings	77.28
Open Water	19.67
Riparian Conifer	1.92
Riparian Meadow	52.36
Riparian Shrub	26.89
Upland Meadow	170.08
Upland Shrub	21.76
Wetland	8.22
Total	**992.69**[1]

Model Selection

Ideally, applications of HEP for comparison in mitigation circumstances would utilize the same cover types and wildlife models existing at the mitigation site as were lost in the original action. The original models chosen at the pool were spotted sandpiper, lesser scaup, Canada goose, great blue heron, yellow warbler, black-capped chickadee, mink, western meadowlark, California quail, and Mallard. Of these, all species except lesser scaup can, at times, be found on the Oxbow Conservation Area. Due to the differences between John Day Project and Oxbow Conservation Area cover types, only a limited section of models were available for use at the Oxbow. 3

HEP Team members and project staff selected oxbow HEP models; i.e., mallard, western meadowlark, mink, yellow warbler, black-capped chickadee, and white-tailed deer. Species model substitution was limited to cases where John Day Project HEP models could not be applied to extant Oxbow Project cover types. White-tailed deer was the only model used for the Oxbow HEP not used in the John Day Dam project HEP.

Table 3. Models applied to Oxbow HEP cover types.

Oxbow HEP cover types	Applied Wildlife Models
Conifer	Black-Capped Chickadee, White-tailed Deer
Irrigated Meadow	Western Meadowlark, Mallard
Upland Meadow	Western Meadowlark, Mallard
Mine Tailings	Western Meadowlark, Mallard
Riparian Meadow	Mallard, Mink, Yellow Warbler
Riparian Shrub	Mallard, Mink, Yellow Warbler
Upland Shrub	White-tailed Deer

[1] Acreage totals do not include roads, residential, or industrial cover types. Acreages based on the 1,022-acre total for the entire property.

Transect Site Selection
Sixty-three possible transect starting points were initially identified encompassing all cover types. Twenty of these random points were chosen for HEP survey transects. Of these, eight conifer transects, one mine tailing transect, four upland meadow transects, two irrigated meadow transects, and four riparian transects including lateral transects in mine tailing, upland meadow, and irrigated meadow cover types were surveyed (Figure 2.) Additional Ocular or "Delphi" transects were also conducted; however, specific site locations are unknown at this juncture.

Field Methods
Field surveys were conducted between May 28 and May 30, 2002. HEP crews located pre-selected random transect sites using handheld Garmin brand GPS units. Transect starting points were marked with rebar, and GPS waypoints were noted on data sheets. Transect azimuths were randomly selected from a random number list. If the selected bearing caused the transect to leave the cover type or property boundary, another random bearing was selected. In certain circumstances, the transect may have a change in direction to avoid obstructions (such as a body of water). Changes in azimuths were noted on the data sheets and with rebar markers on the ground. Digital photographs were taken from the initial starting point of each transect. Transect identification information was displayed on a reader board and included in each photo. Photographs for transects 31, 32, 34, 61, and 63 are unavailable due to camera failure.

Transect lengths varied between cover types and ranged from 200 to 1,000 feet in length. Western meadowlark transects for upland meadow, irrigated meadow, and mine tailings cover types were 200 to 300 feet in length while conifer transects ranged from 600 to 1,000 feet. Occasionally, transect azimuths would change (turn points) to avoid an obstruction, or to remain within the cover type.

Riparian transects were initially set along the river's edge (green line) for 300 feet. Additional paired transects were established perpendicular to the green line transect on each side of the stream generally at the start and stop points. Perpendicular transects varied from 200 to 600 feet due to features or barriers (such as roads or cover type changes). On one transect, perpendicular lines were run from the zero, 150-, and 300-foot marks of the shoreline transect. Habitat variables and data collection techniques for each HEP species are summarized in Table 4.

Table 4. Transect techniques and variables by model.

Species	Technique	Variable
Black-capped Chickadee	Densiometer	V1: % Tree Canopy Cover
	Clinometer	V2: Average Height of overstory trees
	DBH Tape/Quadrat	V4: # of snags 4" to 10" dbh per acre
Mallard	Line Intercept	V3: % Canopy Cover veg. within 100yds.of water w/ emerg. veg.
		V4: % Canopy Cover veg. within 100 to 200 yds. of water
	Tape measure	V5: Height of herb.nesting cover.

Species	Technique	Variable
	Discussion/Ocular	V6: Disturbance by people and dogs
Mink	Aerial Photos/Maps	V1: % of Year Water Present
	Line Intercept	V5: % Canopy Cover <100 yards
		V6: % Canopy Cover <3 ft. of shoreline
Western Meadowlark	Microplot	V1: % Canopy Cover Herbaceous Plants
		V2: % Herb. C.C. Composed of Grass
	Tape Measure	V3: Ave. Ht. of Herb. Canopy
	Tape/range finder	V4: Distance to Perch Sites
	Line Intercept	V5: % Shrub Canopy Cover
White-tailed Deer	Hiding Pole Cover	V1: % Horizontal Concealment
	Densiometer	V2: % Canopy Cover ≥ 35' Tall
	Line Intercept	V3: % Cover Trees and Shrubs ≥ 5' Tall
	Aerial Photos/Maps	V4: Width of Cover type
	Aerial Photos/Maps	V5: Road Density per mile
	Line Intercept	V6: % Preferred Shrub Cover < 5' Tall
	Ocular	V7: Preferred Shrub/Tree Composition
	Ocular	V8: Shrub Browse Diversity
	Microplot	V9: % Palatable Herbaceous Cover
	Aerial Photos/Ocular	V10: % Area Comprised of Winter Wheat/Alfalfa
	Aerial Photos/Maps	V11: Distance Between Cover and Forage Areas
Yellow Warbler	Line Intercept	V1: % Deciduous Shrub Crown Cover
	Tape Measure	V2: Ave. Ht. of Deciduous Shrub Canopy
	Line Intercept	V3: % Deciduous Shrub Canopy Comprised of Hydrophytic Shrubs

Specific Habitat Measurement Techniques

Line Intercept is a method used to measure basal area or canopy cover of herbaceous plants, shrubs, or trees. Collectors follow the transect tape in a straight line may record data at specific intervals. Plant canopies or basal areas are projected vertically to the tapeline and data is recorded to include hits, length of intercept, and species with allowance for overlapping plants.

Microplot square is a method using a 0.5-meter rectangular frame delineated into smaller rectangles and used to estimate the percentage of vegetative cover within. Legs are attached to the frame to elevate the frame 10 cm above the ground. The microplot square was placed along the left side of the transect line every 25 feet for measurements.

Hiding Cover Pole consists of a 1.5 meter PVC pipe divided into three 0.5-meter increments. The cover pole is designed to measure horizontal hiding cover provided by

vegetation and landscape features. Measurements were taken at 50 feet intervals along the transect line. The pole is held vertical and plumb while an observer estimates percent obscurity for each 0.5-meter increment on the pole from four directions (two parallel and two perpendicular to the transect line) from a distance of 45 feet. Both vegetation and landscape features such as rocks, stumps, and depressions, provide hiding cover and are assumed to be of equal value. Percent obscurity is estimated by averaging the four values obtained for each increment. Each 0.5-meter increment of the pole is equal to 33.3% of the total value. The cover value is equal to the mean of the three 0.5-meter increments. Total percent obscurity is determined by calculating a mean from the values obtained at each point along the transect.

Belt transects were used to collect snag data on conifer transects. All snags within 22 feet of either side of the transect line were recorded along with diameter breast height (dbh) information (dbh is snag diameter at 4.5 feet above the ground).

Due to time constraints, Delphi/ocular surveys were performed to fill data gaps and to ensure sufficient data was collected to complete HEP model requirements (Delphi surveys are ocular consensus estimates of habitat variable parameters made by experienced wildlife biologists/managers for a specific cover type). Ocular survey results for mallard (riparian meadow cover type) and white-tailed deer (upland shrub cover type) were included to determine total HUs; however, field data sheets and exact survey observation points are unavailable at this juncture.

Three additional ocular surveys i.e., two riparian shrub (mink and yellow warbler) and one black-capped chickadee, were not used to determine HUs due to a lack of specific cover type information (it is likely these survey data sheets became detached from other transect identification information during the three post survey years). amongst the data from the survey, two riparian shrubs for mink and yellow warbler and one black-capped chickadee in an unknown cover type. These were not used in the HU summary. Although the data sheets indicate GPS points were recorded at the time for these ocular surveys, specific coordinates were not found in the saved data. Ocular HEP are helpful for obtaining additional information due to time constraints, but are difficult to accurately replicate during follow-up studies.

Data Analysis

Field survey data was entered into spreadsheets. Spreadsheet data outputs were applied to appropriate HEP model suitability graphs resulting in SI values (Appendix B). Individual SI values were mathematically aggregated to derive a habitat suitability index for each species model (some models utilize more than one life requisite equation to determine overall HSI). Resulting HSI scores were multiplied by the total acreage for each applicable cover type to determine the number of HUs for each model.

Results

Species model HSI ratings, cover types, cover type acreage, and the number of HUs are summarized in Table 5. There were 701.3 HUs resulting from the project. HSI values were generally marginal and ranged from 0.0 to 0.67. Marginal HSI ratings were usually

due to the lack of shrub components and/or herbaceous cover. Habitat suitability indices are summarized in Appendix B.

Table 5. Baseline Average HSIs and HUs by Species and Cover Type.

HEP Model	Cover Type	Acres[2]	HSI	HUs
Black-capped Chickadee	Conifer Forest	429.76	0.63	270.7
Mallard	Irrigated Meadow	184.75	0.26	48.0
Mallard	Upland Meadow	170.08	0.00	0.0
Mallard	Mine Tailings	77.28	0.21	16.2
Mallard	Riparian Meadow[3]	52.36	0.30	15.7
Mink	Riparian Shrub	26.89	0.66	17.7
Western Meadowlark	Upland Meadow	170.08	0.47	79.9
Western Meadowlark	Mine Tailings	77.28	0.32	24.7
Western Meadowlark	Irrigated Meadow	184.75	0.67	123.8
White-tailed Deer	Conifer Forest	429.76	0.20	86.0
White-tailed Deer	Upland Shrub[4]	21.76	0.40	8.7
Yellow Warbler	Riparian Shrub	26.89	0.36	9.7
Totals		**1851.64**		**701.3**

Discussion

While HEP survey results indicate that overall habitat quality is marginal (≤ 0.4), extant mink, black-capped chickadee and western meadowlark habitat (irrigated and upland meadow cover types), are in fair to good condition. Oxbow Conservation Area management goals and objectives are intended to protect and where possible, increase in the number of habitat units. It should be noted, however, that measurable results and changes in habitat quality may take decades to occur. In addition, natural disturbance and catastrophic events (such as wildfire, flood, insect/disease outbreaks) could reduce/nullify HU increases

Black-capped chickadee scored well with a habitat rating of good. An excellent scoring was impacted by a couple transects lacking snags and one transect with marginal tree canopy. Management plans for the property contain objectives that favor snag preservation and a 60 to 75 percent tree canopy cover.

[2] Acre figures are based on cover type data calculated in GIS from Aerial photos. Acre figures appear larger that actual project acreage due to stacking of HUs (i.e., more than one model was used for some cover types.)
[3] Ocular HEP.
[4] Only white-tailed deer model food and screening cover variables were considered for upland shrub (ocular HEP).

Mallard was limited primarily by the low height of herbaceous nesting cover. Past dredging activities on the property left a large amount of tailings or rock cobble along what was once lush riparian meadows and shrublands. The cobble has significantly reduced the vigor and presence of herbaceous and woody vegetation, affecting the SI scores for mallard, mink, and to a degree, yellow warbler. Mine tailings restoration projects in FY 2005 and FY 2006 are designed to increase shrub cover and improve edaphic conditions for herbaceous vegetation.

Disturbance by people and dogs (mallard model variable) was rated 0.8 (good) because the property manager had a dog and public access is allowed. As riparian buffers increase in area and quality and access becomes limited during nesting periods, this variable could score higher.

Mink and yellow warbler habitat is likely to improve in quantity and quality as mine tailing restoration and continued tree and shrub planting occur in riparian zones on the Oxbow Conservation Area. The lack of woody shrubs was the primary limiting factor for these species..

Western Meadowlark habitat should increase through management that favors restoration of native grassland habitats and grazing practices that maintain a grass height of four to fourteen inches. Invasion by exotic annual grasses are some obstacles to recovery of native grasses, although Western Meadowlark HSI model does not consider differences between native bunchgrass and annual grass habitats. This model can return high habitat values from dense annual grasses in areas generally considered by biologists to be of low habitat value. While meadowlarks may use areas dominated by annual grasses, it should not be assumed that these areas have equivalent values for other wildlife species. Continued care with grazing practices can preserve optimum cover height (of 4-15 inches).

White-tailed deer scored poorly on the on the 430 acres of conifer forest, which had a significant impact on the total number of HUs credited to the project. The project is lacking in many habitat components required by white-tailed deer. Percent horizontal concealment, percent canopy cover equal or greater than 35 feet tall, and percent cover trees and shrubs equal or greater than five feet tall scored poorly. In contrast, preferred shrub and tree composition and shrub browse diversity scored fair to good, but there is room for improvement. Variable 10, percent area comprised of winter wheat or alfalfa, scored 0.0 for all transects, as these agricultural practices are not used on the property or in the area. However, this variable is designed to only enhance HSI scoring and does not decrease the HSI. Changes in property grazing practices that improve shrub development and cover attributes should increase future white-tailed deer habitat suitability.

Future HEP surveys

Future HEP surveys on the Oxbow could prove difficult to compare to this survey. Mine tailing restoration to the property is planned for 2005 and 2006. The restoration will convert the 77 acres of tailings cover into riparian shrub, riparian herbaceous, or irrigated

meadow cover types. The restoration efforts will need many years to recover vegetation for HEP consideration, but should significantly improve HSI scoring potential.

Cover type mapping is likely to improve and may change the name, number and acreage of cover types on the property. To allow comparison to this survey, future HEP surveys should make use of the same cover type map used in this survey or reinterpret the findings of this HEP to the newer map. Also, wetland cover types should be considered for model application in future HEP surveys.

Since 2002, model substitution is a more acceptable practice for mitigation HEP surveys. It may be fitting to substitute models more relative to ecological characteristics and management goals of the Oxbow Conservation Area.

It was seen in this baseline survey that these transects did not complete capture all of the property's habitat characteristics. The Oxbow Conservation Area is a diverse property for its size. Although randomly chosen, some of the transects locations are fairly close to each other, while some of the property is vacant of transects which exhibit different habitat attributes. Adding transects adds to the time and cost of these survey, but may allow for a more accurate look at the property's habitat. The ocular or Delphi surveys used in 2002 for upland shrub white-tailed deer and riparian meadow mallard should not be repeated. Instead, transects should be established for data collection to allow for a measurable result.

Acknowledgements

The Confederated Tribes of Warm Springs would like to acknowledge all of the members of the field HEP team for their hard work, knowledge, and skills they brought to the project. The Tribes would like to extend a special thanks to Paul Ashley for his assistance in preparing for the fieldwork, leading the survey, data analysis, and editing this report.

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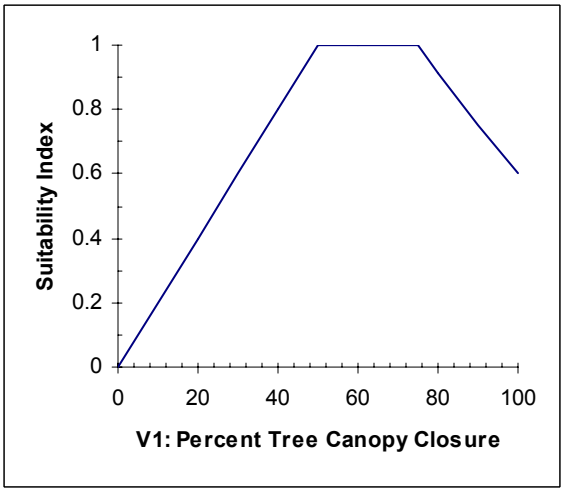
Appendix A – HSI Graphs and life requisite equations for models

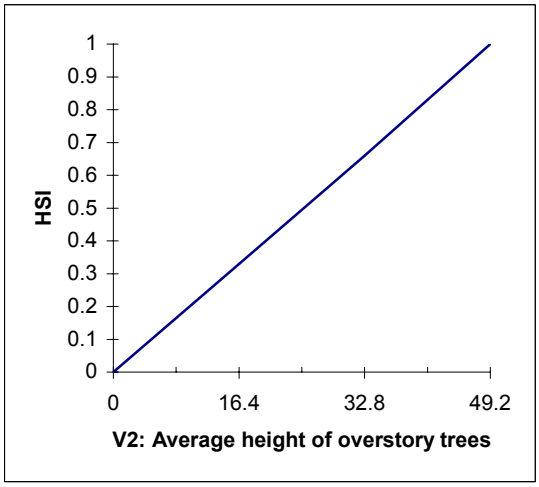
Black-capped Chickadee

HSI determination for black-capped chickadee is based on two life requisite values, food and reproduction. The lower of the two values is equal to the HSI.

Food SI: $(V_1 \times V_2)^{\frac{1}{2}}$

Reproduction SI: V_4





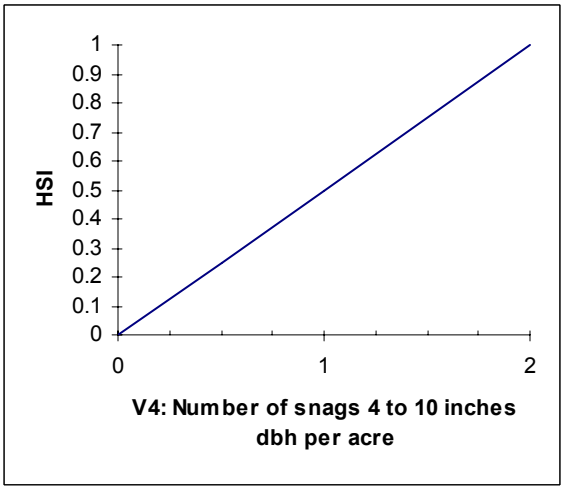


Figure 3. SI Graphs for black-capped chickadee

Mallard

HSI determination for mallard typically is based on the lower SI value of either the nesting cover requisite or brood rearing requisite. However, for the Oxbow HEP, only the nesting cover equation was used.

Nesting Cover SI = $\left[\left(\frac{(2\times V_3)+V_4}{3}\right)\times V_5\right]^{\frac{1}{2}}\times V_6$

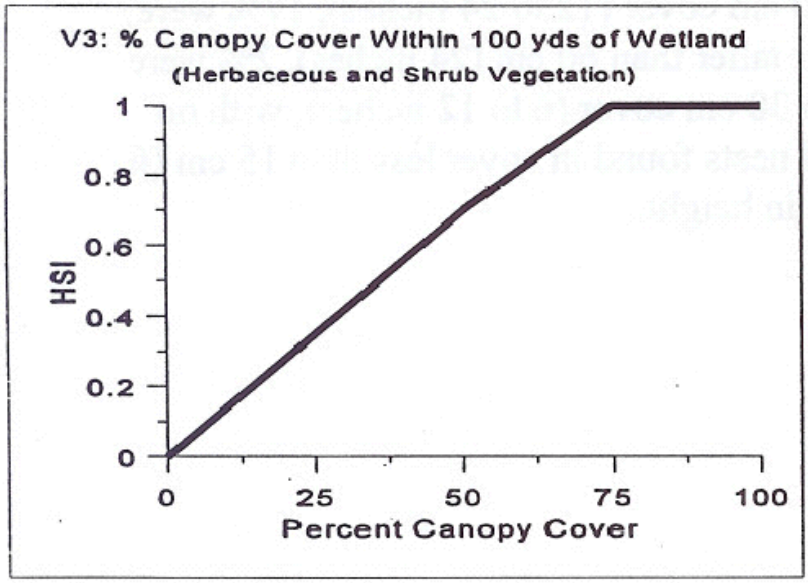


Figure 4. SI Graph for Mallard V3

Percent canopy closure within 100 to 200 yards of wetland was not scored on the Oxbow Conservation Area HEP due to the riparian/floodplain area typically being less than 100 yards. The V4 SI graph is omitted for that reason. It should be noted that the graph is the same as the V3 graph.

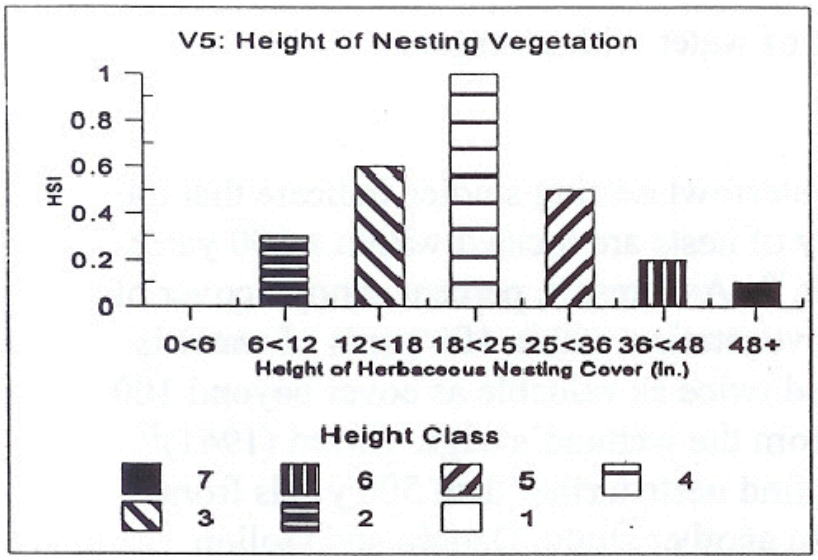


Figure 5. SI Graph for Mallard V5

Variable V6 represents disturbance to the area by people and dogs (public use). Although the SI could be shown as a graph, there are only four possible SI value outcomes.

Disturbance Factor	SI
None	1.0
Low	0.8
Medium	0.5
High	0.1

Mink

Mink HSI is determined by the lower of the two SI values for water and cover.

Water SI: V1

Cover SI: $(V_5 \times V_6)^{\frac{1}{2}}$

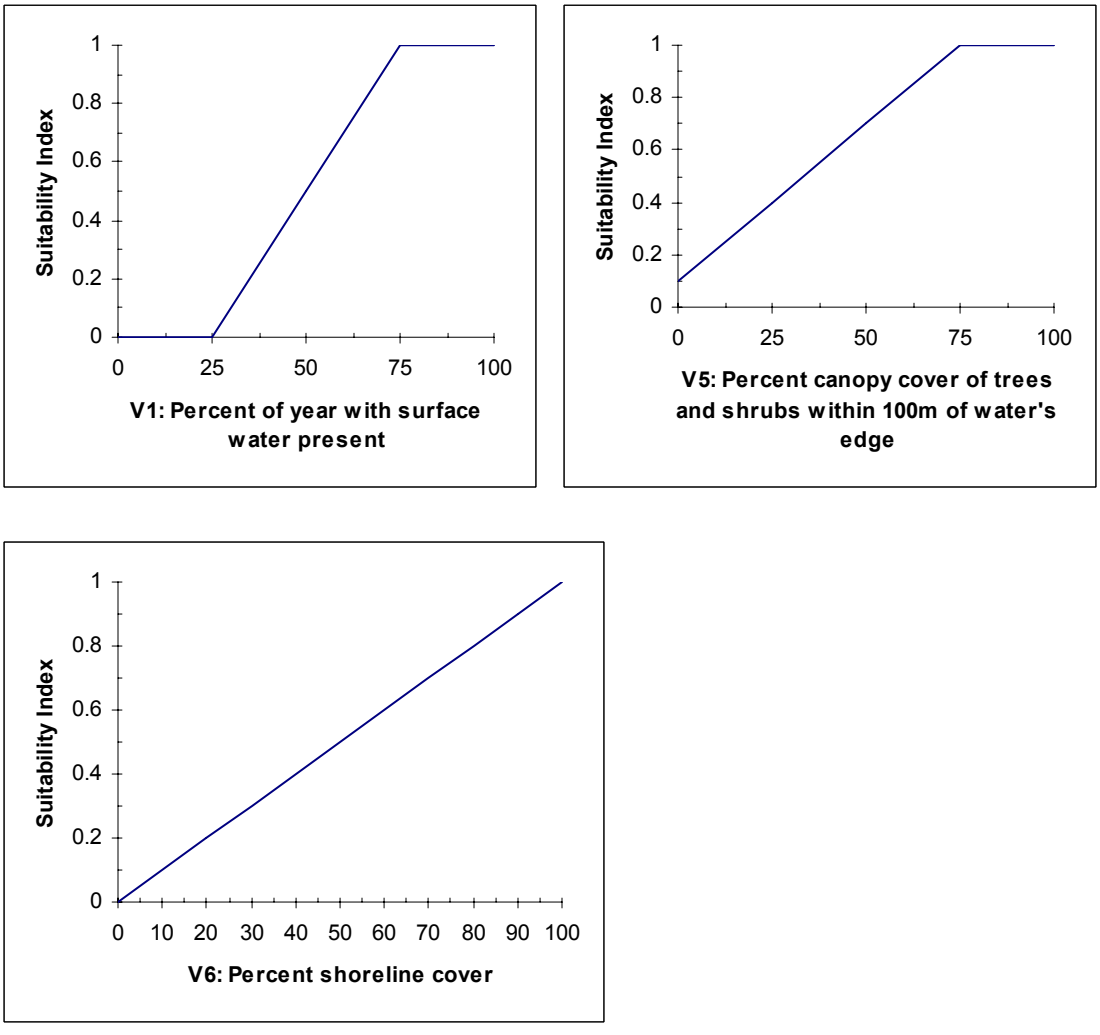


Figure 6. SI Graphs for Mink

Western Meadowlark

Western meadowlark has one life requisite equation for food and reproduction, containing five variables, for calculation of HSI.

$$HSI = (V_1 \times V_2 \times V_3 \times V_4)^{\frac{1}{2}} \times V_5$$

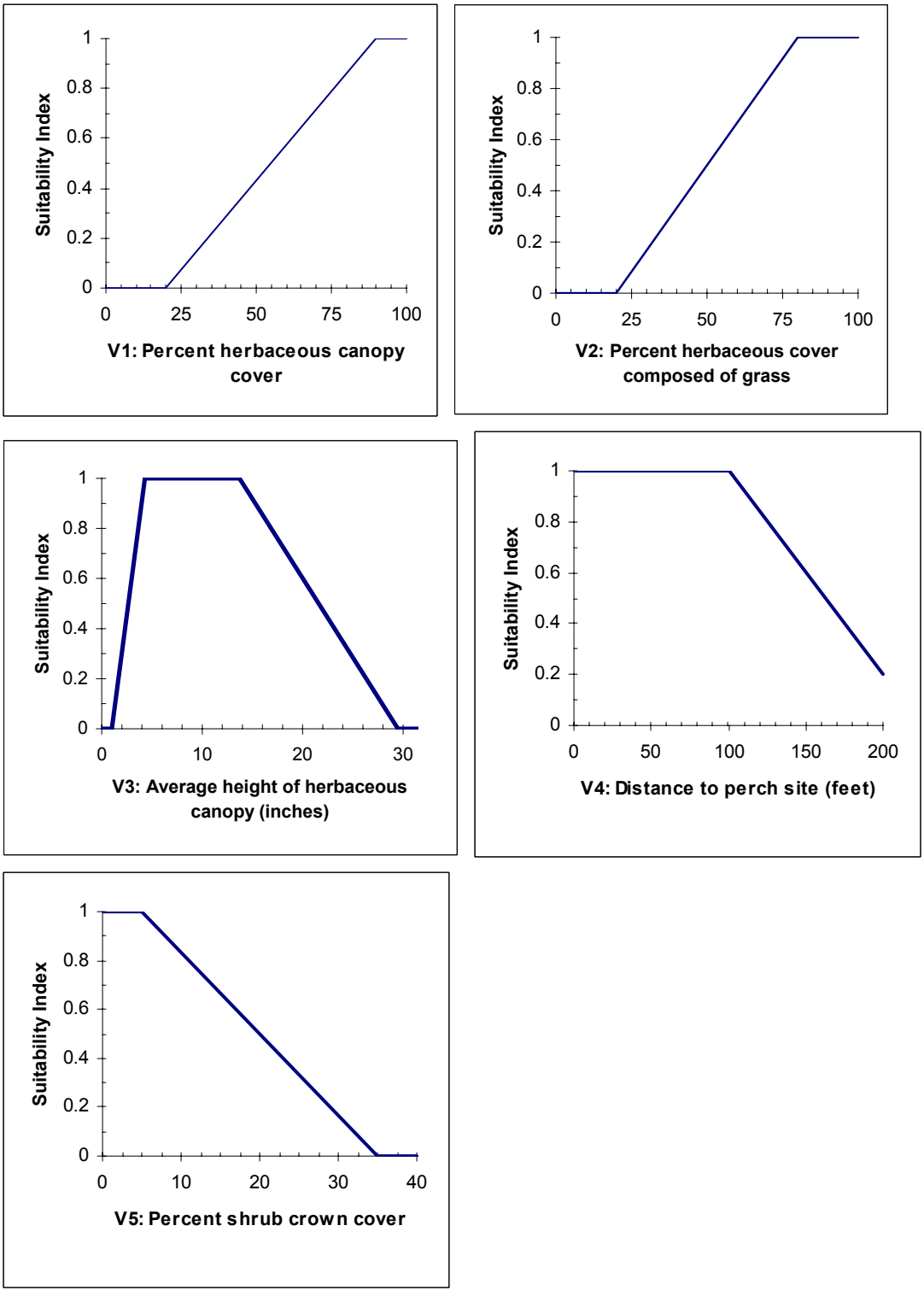


Figure 7. SI Graphs for Western Meadowlark

White-tailed Deer

The white-tailed deer model is a modified draft model developed for the region. The model uses two life requisite equations, cover and food. The HSI is the lower value of the two equations.

Cover SI: $\left[V_1 \times \left(\frac{2 \times V_2 + V_3}{3} \right) \times V_4 \times V_5 \right]^{\frac{1}{4}}$

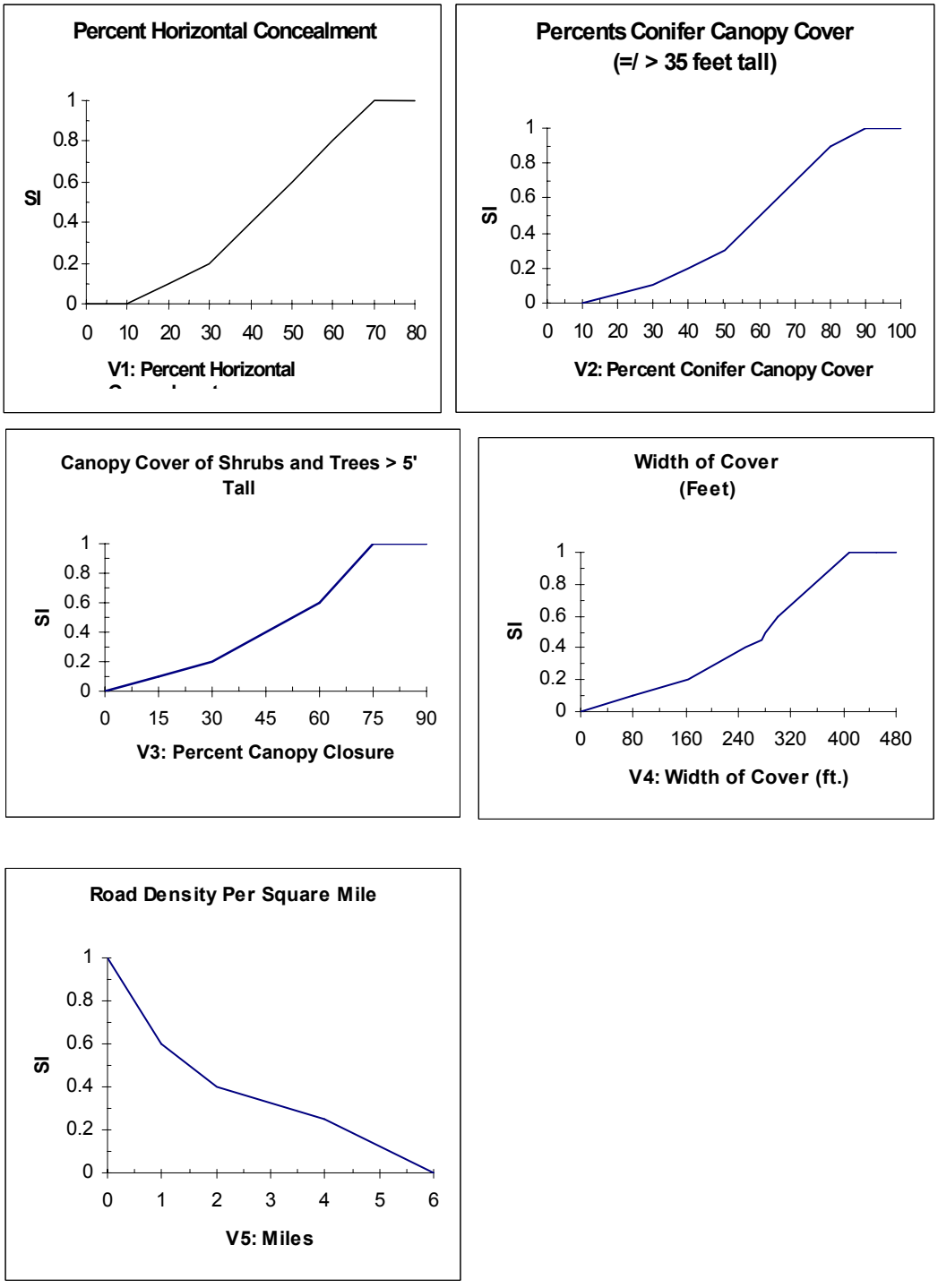


Figure 8. Cover SI Graphs for White-tailed Deer

Food SI: $\left[\left(V_6 \times V_7 \times V_8 \times V_9\right)^{\frac{1}{3}} + V_{10}\right] \times V_{11}$

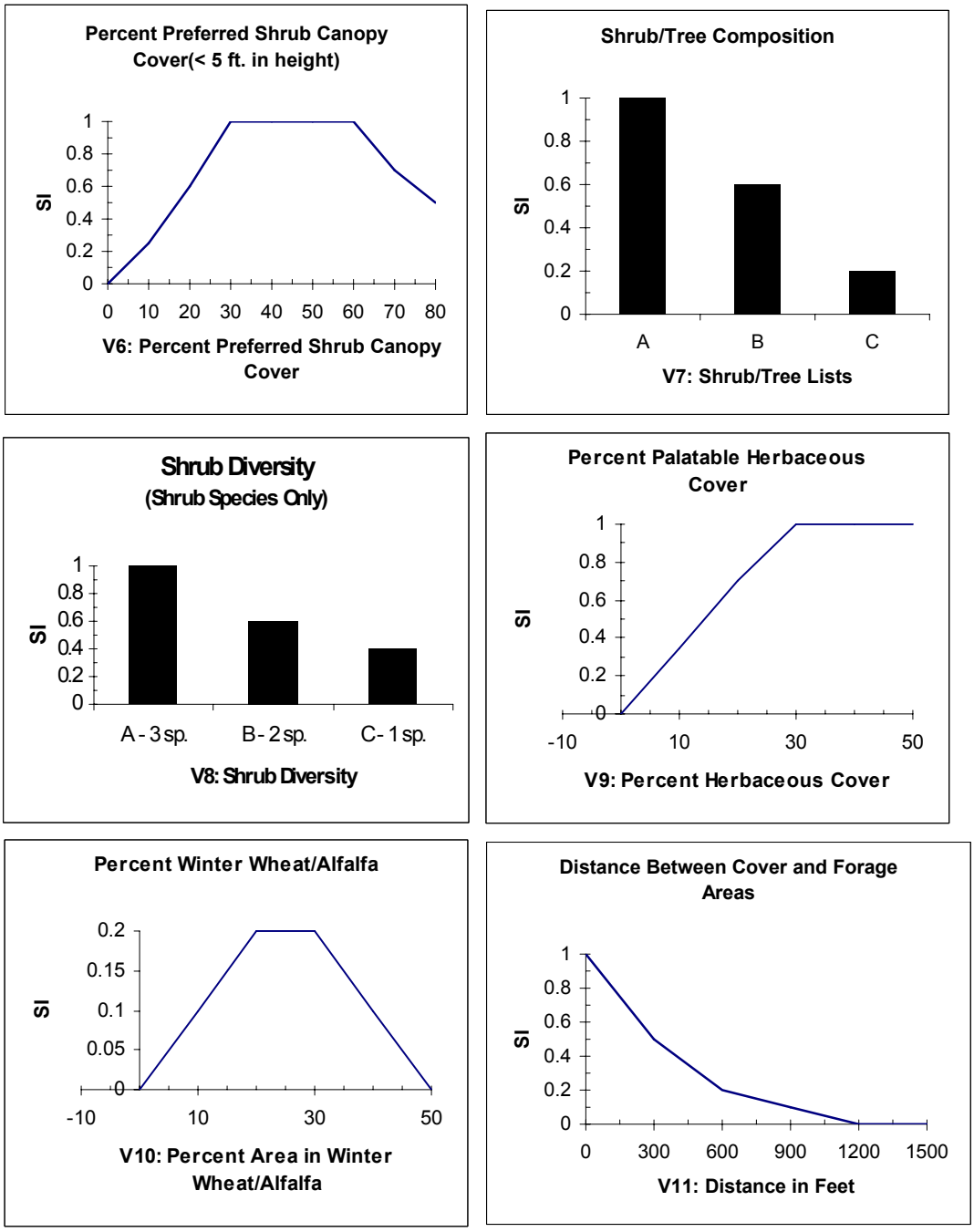


Figure 9. Food SI Graphs for White-tailed Deer

Yellow Warbler

The life requisite equation for yellow warbler is for reproduction, and its value determines the HSI.

$$HSI = (V_1 \times V_2 \times V_3)^{\frac{1}{2}}$$

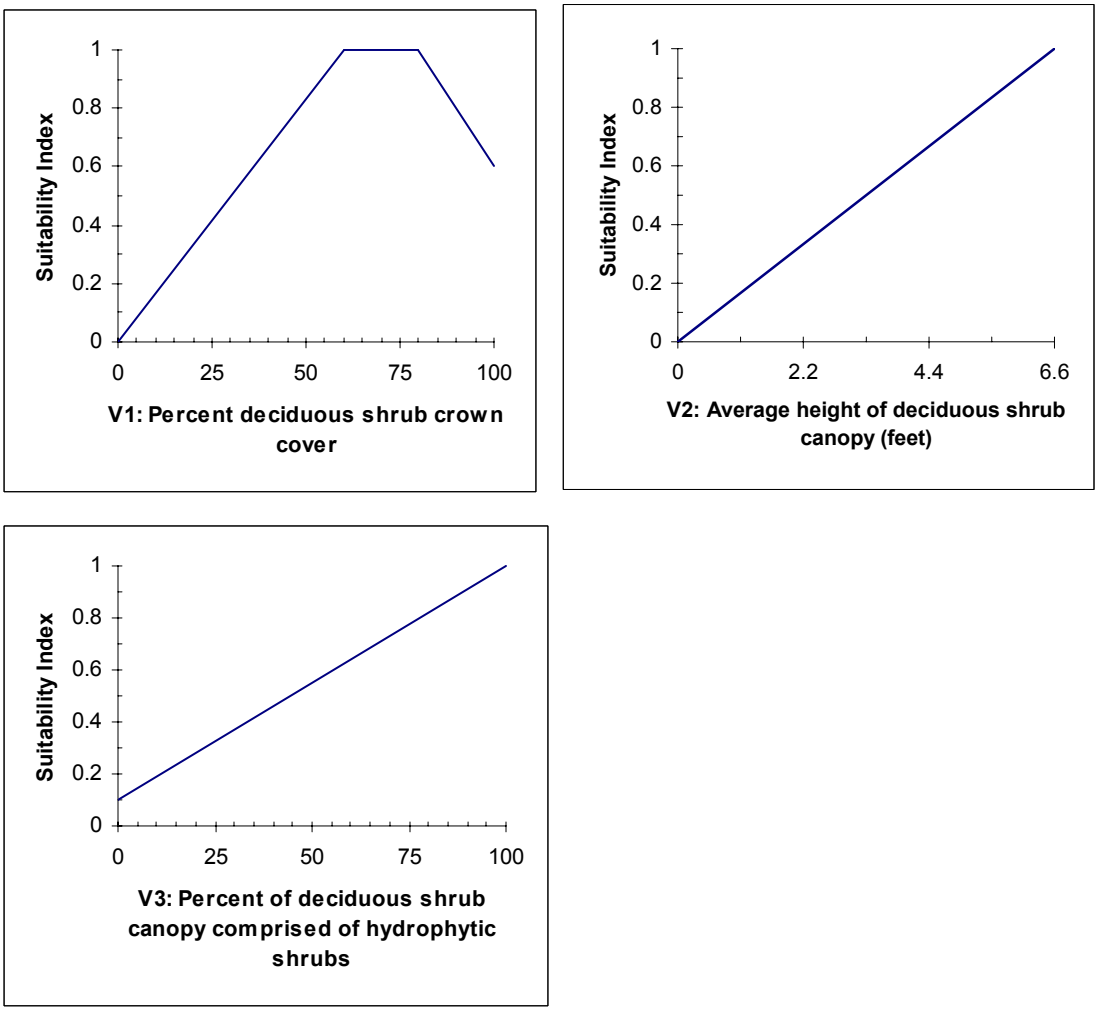


Figure 10. SI Graphs for Yellow Warbler

Appendix B – Suitability indexes by Model and Transect

Table 6. Black-capped chickadee transect data

Cover Type(s):	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer
Transect No.:	**2**	**4**	**5**	**15**	**24**	**32**	**55**	**62**
	SI	SI	SI	SI	SI	SI	SI	SI
V1: % Tree Canopy Closure	1.00	0.73	0.83	0.61	0.38	0.83	1.00	0.90
V2: Ave. Ht. of Overstory Trees	0.95	0.80	1.00	1.00	1.00	1.00	1.00	1.00
V4: # Snags 4 to 10 inch DBH/acre	1.00	0.50	1.00	0.00	0.50	1.00	0.00	1.00
SI Food	0.97	0.76	0.91	0.78	0.62	0.91	1.00	0.95
SI Reproduction	1.00	0.50	1.00	0.00	0.50	1.00	0.00	1.00
Transect HSI	**0.97**	**0.50**	**0.91**	**0.00**	**0.50**	**0.91**	**0.00**	**0.95**

Table 7. Mallard transect data

Cover Type Uplands:	Upland meadow	Upland Meadow	Irrigated Meadow	Irrigated Meadow	Mine Tailings	Mine Tailings
Transect No:	**35N**	**44N**	**36N**	**38N**	**38S**	**35S**
	SI	SI	SI	SI	SI	SI
V3: % C.C. veg. within 100yds. of water w/ emerg. veg.	1.00	0.65	1.00	0.80	1.00	0.70
V4: % C.C. veg. within 100 to 200 yds. of water[5]	0.00	0.00	0.00	0.00	0.00	0.00
V5: Height of herb. nesting cover.	0.00	0.00	0.15	0.20	0.25	0.00
V6: Disturbance by people and dogs	0.80	0.80	0.80	0.80	0.80	0.80
Nesting HSI	**0.00**	**0.00**	**0.25**	**0.26**	**0.33**	**0.00**

Only the nesting SI was used on the Oxbow survey. Other variables could have been used to determine Brood rearing SI, but were not used on this survey.

Table 8. Mink transect data

Cover Type(s):	Riparian Shrub	Riparian Shrub	Riparian Shrub	Riparian Shrub	Riparian Shrub	Riparian Shrub	Riparian Shrub	Riparian Shrub
Transect No.:	**35N**	**35S**	**36N**	**36S**	**38N**	**38S**	**44N**	**44S**
	SI	SI	SI	SI	SI	SI	SI	SI
V1: % Of year with surface water present	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[5] Variable was not used for the Oxbow survey because floodplain width generally was less than 100 yards.

V5: % Canopy cover of trees and shrubs within 100m of wetland edge	0.90	0.65	0.34	0.34	0.48	0.52	0.53	0.53
V6: % Canopy cover within 1m of shoreline	0.83	1.00	0.57	0.57	0.80	0.80	0.98	0.98
Transect HSI	**0.86**	**0.81**	**0.44**	**0.44**	**0.62**	**0.64**	**0.72**	**0.72**

Table 9. Western Meadowlark transect data

Cover Type(s):	Upland Meadow	Upland Meadow	Upland Meadow	Upland Meadow	Upland Meadow	Mine Tailing	Irrigated Meadow	Irrigated Meadow
Transect No.:	**7**	**12**	**31**	**34**	**50**	**39**	**61**	**63**
	SI	SI	SI	SI	SI	SI	SI	SI
V1: % C.C. Herb. Plants	1.00	1.00	1.00	1.00	0.40	0.40	1.00	1.00
V2: % Herb. C.C. Composed of Grass	0.25	0.40	0.60	0.40	1.00	1.00	0.90	0.10
V3: Ave. Ht. of Herb. Canopy	0.40	1.00	0.50	0.40	0.10	0.25	0.80	1.00
V4: Distance to Perch Sites	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V5: % Shrub Canopy Cover	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	**0.32**	**0.63**	**0.55**	**0.40**	**0.20**	**0.32**	**0.85**	**0.32**

Table 10. White-tailed deer transect data.

Cover Type(s):	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer	Conifer
Transect No.:	**2**	**4**	**5**	**15**	**24**	**32**	**55**	**62**
	SI	SI	SI	SI	SI	SI	SI	SI
V 1: % Horizontal Concealment	0.14	0.03	0.00	0.06	0.20	0.27	0.43	0.25
V 2: % Canopy Cover =/> 35' Tall	0.00	0.20	0.29	0.20	0.06	0.20	0.15	0.30
V 3: % Cover Trees and Shrubs =/> 5' Tall	0.03	0.00	0.00	0.04	0.00	0.01	0.03	0.00
V 4: Width of Cover	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V 5: Road Density per mile^2	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Cover SI	**0.17**	**0.24**	**0.00**	**0.29**	**0.28**	**0.41**	**0.44**	**0.45**
V 6: % Preferred Shrub Cover < 5' Tall	0.00	0.00	0.03	0.00	0.19	0.06	0.00	0.00

V 7: Preferred Shrub/Tree Composition	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
V 8: Shrub Browse Diversity	0.36	0.40	0.40	0.42	0.30	0.40	0.40	0.40
V 9: % Palatable Herbaceous Cover	1.00	1.00	1.00	1.00	0.60	1.00	1.00	0.80
V 10: % Area Comprised of Winter Wheat/Alfalfa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V11: Distance Between Cover and Forage Areas	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Food SI	**0.00**	**0.00**	**0.20**	**0.00**	**0.28**	**0.25**	**0.00**	**0.00**
Transect HSI	**0.00**	**0.00**	**0.00**	**0.00**	**0.28**	**0.25**	**0.00**	**0.00**

Table 11. Yellow Warbler transect data.

Cover Type(s):	Riparian Shrub	Riparian Shrub	Mine Tailings Riparian Shrub	Riparian Shrub
Transect No.:	**35**	**36**	**38**	**44**
	SI	SI	SI	SI
V1: % Deciduous Shrub Crown Cover	0.83	0.77	0.87	0.83
V2: Ave. Ht. of Deciduous Shrub Canopy	0.40	0.10	0.80	0.90
V3: % Deciduous Shrub Canopy Comprised of Hydrophytic Shrubs	0.20	0.20	0.50	0.25
Transect HSI	**0.26**	**0.12**	**0.59**	**0.43**

Appendix C – Transect Data and Photos

Transect 2

Cover Type: Conifer

Transect Length: 900 feet (20˚ azimuth)

GPS Start point UTM 365890E, 4945533N

Figure 11. Transect 2 photo point, May 29, 2002

Transect 4

Cover Type: Conifer

Transect Length: 700 feet (180˚ azimuth), then 200 feet (90˚ azimuth)

GPS Start point UTM 366514E, 4945926N

Figure 12. Transect 4 photo point, May 29, 2002

Transect 5

Cover Type: Conifer

Transect Length: 300 feet (250˚ azimuth), then 300 feet (205˚ azimuth), then 300 feet (250˚ azimuth)

GPS Start point UTM 366697E, 4945926N

Figure 13. Transect 5 photo point, May 29, 2002

Transect 7
Cover Type: Upland Meadow
Transect Length: 300 feet (0˚ azimuth)
GPS Start point UTM 366723E, 4946505N

Figure 14. Transect 7 photo point, May 29, 2002

Transect 12
Cover Type: Upland Meadow
Transect Length: 300 feet (128˚ azimuth)
GPS Start point UTM 366444E, 4946425N

Figure 15. Transect 12 photo point, May 29, 2002

Transect 15

Cover Type: Conifer

Transect Length: 1000 feet (210˚ azimuth)

GPS Start point UTM 366524E, 4945404N

Figure 16. Transect 15 photo point, May 28, 2002

Transect 24
Cover Type: Conifer
Transect Length: 300 feet (200˚ azimuth), then 600 feet (290˚ azimuth)
GPS Start point UTM 366305E, 4945532N

Figure 17. Transect 24 photo point, May 28, 2002

Transect 31
Cover Type: Upland Meadow
Transect Length: 300 feet (82˚ azimuth)
GPS Start point UTM 368196E, 4945305N
No photo available

Transect 32
Cover Type: Conifer
Transect Length: 600 feet (340˚ azimuth), then 300 feet (70˚ azimuth)
GPS Start point UTM 367987E, 4945158N
No photo available

Transect 34
Cover Type: Upland Meadow
Transect Length: 300 feet (144˚ azimuth)
GPS Start point UTM 368296E, 4945201N
No photo available

Transect 35
Cover Type: Riparian

Transect Length: Greenline 300 feet, Northernly A- 250', B- 200', Southernly A- 600', B- 600'
GPS Start point UTM 367948E, 4945067N

Figure 18. Transect 35 greenline photo point, May 30, 2002

Figure 19. Transect 35N photo point

Transect 36

Cover Type: Riparian

Transect Length: Greenline 300 feet, Northernly A- 300', B- 600', Southernly A- 600', B- 500'
GPS Start point UTM 367024E, 4945522N

Figure 20. Transect 36 greenline photo point, May 30, 2002

Figure 21. Transect 36N photo point

Transect 38

Cover Type: Riparian

Transect Length: Greenline 300 feet, Northernly A- 300', B- 600', Southernly A- 600', B- 600'
GPS Start point UTM 368348E, 4944659N

Figure 22. Transect 38 greenline photo point, May 30, 2002

Figure 23. Transect 38N photo point

Transect 39

Cover Type: Mine tailings

Transect Length: 300 feet (115° azimuth)
GPS Start point UTM 368297E, 4944736N

Figure 24. Transect 39 photo point, May 30, 2002

Transect 44

Cover Type: Riparian
Transect Length: Greenline 300 feet with A at 0', B at 150', and C at 300'; Northerly A- 300', B- 300' C- 500 , Southerly A- 600', B- 600', C- 600'
GPS Start point UTM 368899E, 4944504N

Figure 25. Transect 44 greenline photo point, May 30, 2002

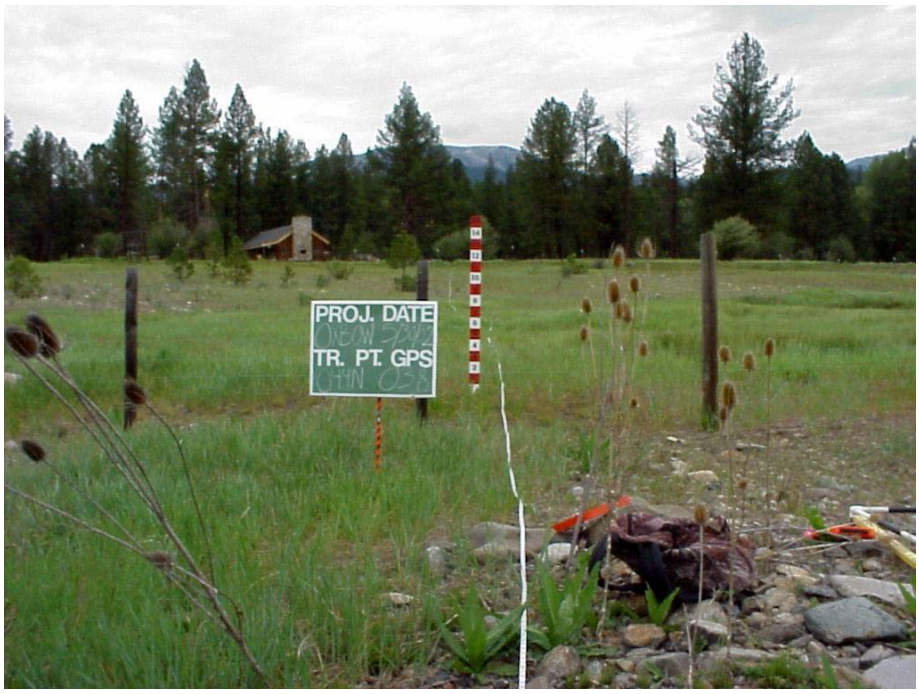


Figure 26. Transect 44N photo point

Transect 50

Cover Type: Upland Meadow

Transect Length: 200 feet (40˚ azimuth)

GPS Start point UTM 369684E, 4943927N

Figure 27. Transect 50 photo point, May 28, 2002

Transect 55
Cover Type: Conifer
Transect Length: 900 feet (70˚ azimuth)
GPS Start point UTM 369333E, 4944047N

Figure 28. Transect 55 photo point, May 28, 2002

Transect 61
Cover Type: Irrigated Meadow
Transect Length: 300 feet (80˚ azimuth)
GPS Start point UTM 369490E, 495362N
No Photo Available

Transect 62
Cover Type: Conifer
Transect Length: 600 feet (107˚ azimuth)
GPS Start point UTM 369512E, 4944596N

Figure 29. Transect 62 photo point, May 29, 2002

Transect 63

Cover Type: Irrigated Meadow
Transect Length: 300 feet (55˚ azimuth)
GPS Start point UTM 369388E, 4944887N
No Photo Available